BYU IDAHO | Department of Computer Science & Electrical Engineering

# Faye Navarro: Part A

## Introduction

Faye Navarro was a software engineer with a reputation for creating extremely stable and robust systems. As a result, no one was surprised when she was promoted to quality assurance manager at Sherwin Aircraft, a company noted for its high-quality products. Terrence Baird was a relatively new engineer with an idea that promised to revolutionize manufacturing. As a result, many customers were excited when Sherwin bought his start-up company to improve their new engine.

Faye was used to facing challenges. She didn't realize, however, that Terrence would be one of them. Driven by a personal tragedy, Terrence was unrelenting when it came to improving safety. Everything he did was fueled by a sense of extreme urgency. Faye's calm and measured approach was often at odds with Terrence's frantic pace. While they learned to work together, the relationship was always tense. As the project deadline grew closer, the tension between them rose to new heights.

Faye knew the software wasn't perfect but Terrence wanted to install it anyway. A recent airplane accident seemed to add greater weight to his normal insistence. She also knew what would happen if the software crashed. Could Sherwin recover from the consequences? At a meeting with several other managers the final decision was given to Faye. Pondering the situation in her office later on she surprised herself. For the first time since becoming and engineer, she simply didn't know what to do. What should she decide?

## Sherwin Aircraft

On April 14, 2018, a single-engine Piper Arrow crashed after its left wing snapped off at a height of 900 ft. The pilot and his trainer both died when the rest of the plane slammed into a field two miles from the airport. According to the National Transportation Safety Board, the 10-year old airplane had been used for significantly more takeoffs than others used to train new pilots. Flight records indicate the airplane had been used for 33,000 takeoffs in 7,700 hours of flight time or one every 15 minutes. The extra stress created cracks in the metal of the left wing's main support which led to the fatal crash that Saturday morning.

This incident and several others, including Sichuan Airlines flight 8633 and Southwest Airlines flight 1380, led to much greater scrutiny of airplane and parts manufacturers alike. One airline, Qatar Airways, even refused to accept deliveries for new airplanes after production mistakes came to light. The pressure on the manufacturing side of the industry climbed to even greater heights. Sherwin Aircraft, a company with an established reputation for innovation and quality, was no exception.

Sherwin Aircraft Company was founded in 1985. The company started by focusing on the design and manufacture of open-rotor engines. Open-rotor engines were distinguished from other types by two rows of counter-rotating blades or propellers. The forward propeller pushed air backwards while the rear one drew it in. The result was a highly efficient engine that would lower the cost of flying compared to other alternatives. Sherwin Aircraft's engine was quickly

recognized as one of the highest quality options on par with makers like McDonnell Douglas and others.

Unfortunately, as the price of fuel declined the market turned its attention to other types of engines. Sherwin Aircraft was forced to make a hard decision. That is, reinvent itself or close its doors for good. The company decided to reinvent itself by focusing exclusively on propeller materials and design for conventional turboprop engines. The strategy turned out to be a good one. Not only did they survive, they thrived. The Sherwin values of innovation and quality helped them quickly establish their propeller blades as the best in the market.

Three decades later the price of fuel reversed direction and started to climb again. The higher cost of flying combined with growing concern over engine emissions reignited interest in the open-rotor design. Though firmly established as a propeller manufacturer, Sherwin decided to reintroduce an updated version of their original engine to the market. Worried about competitors, they decided to fast track the work by purchasing several start-up companies including one called Baird Scientific. They hired its owner, Terrence Baird, to develop a program that promised to catapult the quality of their engine far beyond any other.

**Baird Scientific**

Terrence Baird had only been a mechanical engineer for two years when he heard about the accident. His older sister, Jamie Baird, was travelling from Howrah to Puri, India when the passenger train she was on derailed. The leading locomotive had broken an axel. Several people were seriously injured. Some of those, including Jamie, died. Inspectors attributed the break to several factors including worn out parts.

Terrence was devasted by Jamie's death. Amidst the sorrow he started to change the way he thought about work. Many manufactured parts are designed with a safe-life perspective in mind. That is, parts are expected to start out with small flaws and be replaced before they become critical. From Terrence's perspective this was pointless. Parts should never need to be replaced!

This new way of thinking took hold of Terrence. It wasn't long before he had devised a way to more accurately reveal microscopic flaws in metal. The new approach used deep learning, neural networks and ultrasonic technologies to classify and localize defects. The end result was a system of software and sensors that could be installed in regular manufacturing facilities to produce significantly higher quality parts.

Terrence knew his method could really change things. Imagining the possibilities, he started his own company, Baird Scientific, to sell it. It turns out that convincing manufacturers to buy the system wasn't hard at all. Delivering one that worked was another. Eager to get his product in the hands of manufacturing companies, Terrence pushed hard to ship the software, even if it hadn't been tested. Feeding off his energy, Terrence's sales people and other staff supported him. Unfortunately, every time the software was installed at a customer site it crashed. One time it took down the entire factory.

Driven by his mission, Terrence pushed on. It was at this critical moment that Sherwin Aircraft offered to buy the company. Terrence wasn't sure if he should accept their offer at first. All he could think about was preventing accidents like the one Jamie was in. When he learned they wanted to hire him to finish the software his worries went away. Terrence accepted the offer and joined Sherwin Aircraft as their new Vice President of Software Engineering.

**Getting to Work**

If you asked Faye Navarro when she started her career she'd say it was in junior high school. Her first commissioned work was an admissions lottery program she wrote for school administrators. After completing high school and a university degree in mathematics she started working for a semi-conductor manufacturer. Though she started out with small coding assignments, it wasn't long before they noticed her talent. Soon she was writing factory planning and scheduling systems. In seven years with the company her software only crashed twice. Faye's employers knew they could rely on the quality of her work.

Ready for a change, Faye started watching the market for new job opportunities. That's when she discovered Sherwin Aircraft. The company's vision, with its emphasis on quality, seemed a perfect fit with her own professional philosophy. She applied for a job as a software engineer and got it. Faye started work at her new position in August of 2016. To her great surprise, she was promoted to Quality Assurance Manager almost immediately.

A few days after her promotion, Faye ran into Kelsey Hunter, the Chief Technology Officer. Kelsey greeted her warmly and asked, "how are you liking your new position?" Faye responded enthusiastically. Kelsey continued, "That's great. You're going to need that attitude. And remember, we need someone who can say no!" Faye was a little puzzled but didn't think too much of it.

Not long after her encounter in the hallway, Faye was asked to start working with the software development team on an existing project. Her first task was to meet with them and determine how quality assurance could be integrated. Faye flew to London where she was met by Terrence Baird, the Vice President of Software Engineering.

After a day of meetings, Faye thought she was starting to understand what Kelsey meant in the hallway. Even though Terrence's team wrote lots of new code they never tested it. If they became aware of any bugs they never combined their fixes. There didn't seem to be a consolidated, fully tested version of the software anywhere.

Faye knew her success meant getting people to change. She would have to teach the software engineering team best practices like branching the code, merging the changes, and working with quality assurance to test it. The biggest challenge would be convincing Terrence Baird it wasn't his job to decide when the software was ready. There were so many factors to consider including sales goals, legal requirements, user expectations, internal budgets and others. From Fay's point of view, it had to be a joint decision made by several departments, not just by Terrence.

Two weeks later, the software engineering and quality assurance teams met to officially begin work together. Faye wasn't surprised as she listened to Terrence open the meeting. He held up a flash drive containing the latest version of the software. "Quality is important at Sherwin," he said. "That's why we've taken great care to make sure it's working. In fact, it really doesn't need tested at all." He seemed very excited as he talked.

Faye continued to listen. Terrence had changed his focus to her department. Did they have enough space? Did they have good computers? How could he help them? He seemed very concerned about her department's equipment. Still thinking about his earlier comments, Faye asked if they could look at the new version over lunch. Terrence agreed. With two of her testers helping her, Faye installed the software on a nearby computer and started it up. It crashed immediately.

Faye recounted what happened when everyone else returned from lunch. Terrence seemed to lose his composure almost at once. Looking directly at Faye he yelled in a very loud voice, "I told you it didn't need tested!" Faye replied calmly, "We just wanted to see how it worked."

**Preparing to Install**

Things seemed to go better after Terrence's initial outburst. He still raised his voice fairly regularly but Faye was getting used to it. She listened carefully to what he had to say and responded calmly but directly. She made a point of recognizing and implementing as many of the software engineering team's suggestions as she could. Over time, they developed a working rhythm that seemed to get things done. They made great improvements to the software but unfortunately there were still problems.

As the installation date grew closer, Faye knew it was time for everyone involved to meet together. During the meeting, Faye, Terrence, and several other department managers ranked the remaining defects in order of importance. Terrence took the list with a promise to work with Faye and deliver a new version two weeks later.

When the group reconvened, Faye brought them up to speed. Several defects on the list had been fixed. In fact, the software now passed 80% of their tests. Unfortunately, others still remained. As the discussion continued, two opinions began to emerge. Less than half the group thought they should delay the installation. The remaining people in the room thought they should install it immediately.

One of the managers even brought up a recent airplane accident in which four people, including the pilot, died. The official report revealed a propeller spar had fractured under tension at a fatigue crack. Investigators found a part number in the wreckage and traced it back to Sherwin Aircraft. It was one of their propellers.

Unable to contain himself any further, Terrence looked at Faye and began to speak, "If you'd stop finding defects we could install it. We can stop these accidents from happening right now." Terrence's voice grew louder as he continued, "Let me remind you that I am the Vice President of Software Engineering. You are a quality assurance manager. We need to do as I say!"

Kelsey wasn't an engineer. She relied heavily on everyone in the room to help make these decisions. A few more seconds ticked by as she deliberated. Finally, Kelsey turned to Faye, "It's true, you're the quality assurance manager, and the last one to weigh in. I'm leaving the decision up to you."

**Making the Decision**

Faye wasn't surprised when Kelsey delegated the decision to her. This was exactly the kind of situation her role was created for. Faye acknowledged everyone's contributions and then asked for an additional day to decide. Kelsey agreed.

When Faye returned to her office she reviewed her notes from the meeting. There were a lot of different viewpoints to consider. Each person seemed to have a different opinion. None of them were bad. In fact, all of them seemed good in their own way. Some were actually very compelling.

She understood the reason for Terrence's passionate outbursts. He wasn't the only one who wanted to see the new technology put to use. Many of Sherwin's customers were watching too. With the latest accident fresh in everyone minds, there seemed to be a lot riding on this one.

Closing her eyes, Faye let her mind drift to a recent experience at church. She was called to serve as Relief Society President one week before. The sister missionaries asked her to visit to a woman named June with them, almost immediately. They planned to ask June to be baptized and wanted Faye to share her testimony. As they all met up and talked, it was clear that June wasn't ready. The missionaries invited her to be baptized anyway. Following their lead, Faye shared her testimony. Two days later, June contacted the missionaries to let them know she didn't want any more visits. She wasn't interested in being a member of the church anymore.

Faye wasn't sure why this experience came to mind. Returning to her present problem, she logged in to her email, clicked the "new" button, and started typing a message to the other managers. She paused with the realization that she still hadn't decided. Normally, she was very sure of herself. Looking at the screen she wondered out loud, "What should I do?"

**Exhibit 1**

Sherwin Aircraft's Mission Statement

*To continue our history of excellence by providing the highest quality and most reliable products to our customers.*

**Exhibit 2**

Aircraft Accident Statistics

| Causes of Fatal Accidents by Decade[1] | | | | | | | |
|---|---|---|---|---|---|---|---|
| Decade | 1950s | 1960s | 1970s | 1980s | 1990s | 2000s | 2010s |
| Pilot Error | 50% | 53% | 49% | 42% | 49% | 50% | 57% |
| Mechanical[2] | 26% | 27% | 19% | 22% | 22% | 23% | 21% |
| Weather | 15% | 7% | 10% | 14% | 7% | 8% | 10% |
| Sabotage | 4% | 4% | 9% | 12% | 8% | 9% | 8% |
| Other | 5% | 9% | 13% | 10% | 14% | 10% | 4% |

[1] see http://planecrashinfo.com
[2] mechanical failures include engine, equipment, and structural failures, and design flaws

| Survival rate of passengers on aircraft involved in fatal accidents carrying 19+ passengers[1] | |
|---|---|
| Decade | Survived |
| 1940s | 24% |
| 1950s | 25% |
| 1960s | 21% |
| 1970s | 25% |
| 1980s | 36% |
| 1990s | 39% |
| 2000s | 28% |
| 2010s | 27% |

[1] see http://planecrashinfo.com